REMARKS

Entry of this Amendment and reconsideration and allowance of this application, as amended, are respectfully requested.

Amended claims 9 and 15 correspond to claims 21 and 22. Newly presented claims 23 and 24 are supported by the specification, as originally filed, at page 18, lines 23-25.

The prior art grounds of rejection are respectfully traversed.

Claims claims 1, 4, 9, 12, 15, 18, 21 and 22 stand rejected under §35 U.S.C. 103(a) as being obvious over Nishiyama et al. (US 6,507,385 B1), Wang et al. (US 6,181,390 B1) and Aastuen et al. (US 5,669,139).

Claims 2, 5, 7, 10, 13, 16 and 19 stand rejected under §103(a) as being obvious over Nishiyama et al., Wang et al., Aastuen et al. and Imabayashi et al. (US 6,535,264 B1).

Claims 3, 6, 8, 11, 14, 17 and 20 stand rejected under §103(a) as being obvious over Nishiyama et al., Wang et al., Aastuen et al. and Kashimoto et al. (US 6,157,433). These grounds of rejection is respectfully traversed.

The following generally describes our claimed inventions.

When an LCD panel is arranged horizontally, gravity that acts on a liquid crystal material only includes a component which acts in a direction perpendicular to a main surface of a substrate. Thus, pressure acting on the liquid crystal material is evenly distributed in a liquid crystal layer.

On the other hand, when the LCD panel is positioned to "stand", gravity that acts on the liquid crystal material only includes a component which acts in a direction parallel to the main surface of the substrate. As a result, pressure acting on the liquid crystal material is greater at one end of the liquid crystal layer, compared with pressure acting on the liquid

crystal material at another end of the liquid crystal layer. Thus, pressure is applied unevenly to the liquid crystal material.

Therefore, even if all columnar spacers of a horizontally arranged LCD panel were in contact with both substrates, columnar spacers may separate from one of the substrates when the LCD panel is positioned to "stand". Such a separation is easily caused when the liquid crystal material is thermally expanded.

Our claim 9 invention solves this problem by using a liquid crystal material with a volume expansion coefficient of 0.65×10^{-3} °C^{-1} to 0.85×10^{-3} °C^{-1}, and by defining H_0, H_1, β and ΔD_1 to satisfy a relationship represented by an inequality: $H_0 - H_1 + 25 \times \beta \times H_0 > \Delta D_1 + 0.01$ μm.

According to our claim 15 invention, a liquid crystal material with a volume expansion coefficient of 0.65×10^{-3} °C^{-1} to 0.85×10^{-3} °C^{-1} is used, and H_0, H_1 and ΔD_1 are defined to satisfy a relationship represented by an inequality: $H_0 - H_1 > \Delta D_1 + 0.01$ μm.

With the inequalities recited in claims 9 and 15, the right side is not ΔD_1, but $\Delta D_1 + 0.01$ μm. When each right side of the inequalities is $\Delta D_1 + 0.01$ μm, and when pressure is unevenly distributed in a liquid crystal layer and an LCD panel is positioned to "stand", columnar spacers can be prevented from separating from one of the substrates.

Nishiyama et al. teach a liquid crystal display element (Figure 1) that includes a column-shaped spacer 3. Column 9, lines 28-31 describes:

> "The above-mentioned spacer 3 has an elasticity and is in a state of elastic deformation within a range (0 to 85 °C in Embodiment 1) of usable temperatures of a liquid crystal display element".

However, Nishiyama et al. does not describe that the spacer 3 is elastically deformed while the liquid crystal display element is made to stand. Nishiyama et al. does

not describe that the liquid crystal device element is positioned to "stand" during use of the element.

Furthermore, as the Examiner admits in the Official Action (page 3, line 14 through page 4, line 2 and page 4, lines 10-19) that Nishiyama et al. does not disclose that H_0, H_1, β and ΔD_1 satisfy a relationship represented by an inequality: $H_0 - H_1 + 25\times\beta\times H_0 > \Delta D_1 + 0.01$ μm, or that H_0, H_1 and ΔD_1 satisfy a relationship represented by an inequality: $H_0 - H_1 > \Delta D_1 + 0.01$ μm.

Moreover, Nishiyama et al. does not disclose applying H_0, H_1, β and ΔD_1, defined in claim 9 of the present application, as parameters In addition, the references does not disclose applying H_0, H_1 and ΔD_1, defined in claim 15 of the present application, as parameters.

The Wang et al. reference merely discloses a stand 30 firmly retaining an LCD panel 10 (Figure 2).

The Aastuen et al. reference merely discloses an example wherein a coefficient of thermal expansion of liquid crystal material is 8.5×10^{-4}/°C (in column 7, lines 28-29).

Imabayashi et al. merely discloses that "a temperature of liquid crystal molecules change from 25 degrees at ON (OFF) state of a backlight unit to 55 degrees at OFF (ON) state of a backlight unit" (column 8, lines 7-9).

Kashimoto et al. merely discloses a device with a display region having a diagonal dimension of 12.1 inches.

The Examiner states at page 4, lines 3-9 of the action:

> "It would have been obvious to one having ordinary skill in the art at the time the invention was made to have the invention satisfy the relationship represented by $H_0 - H_1 + 25*\beta*H_0 > \Delta D_1$, where the left side of the inequality is larger than the right side by at least .01 microns since manipulating a relationship with already known parameters to obtain optimum results requires routine skill in the art. Moreover, such an inequality would enable the display to maintain uniformity at temperature greater than 50 degrees Celsius, due to the increase range in which the spacers maintain deformity."

Furthermore, the Examiner states on page 4, line 20 through page 5, line 4:

> "It would have been obvious to one having ordinary skill in the art at the time the invention was made to have the invention satisfy the relationship represented by H0 - H1 > ΔD1, where the left side of the inequality is larger than the right side by at least .01 microns since manipulating a relationship with already known parameters to obtain optimum results requires routine skill in the art. Moreover, such an inequality would enable the display to maintain uniformity at temperature greater than 50 degrees Celsius, due to the increase range in which the spacers maintain deformity."

However, the Examiner does not specifically describe what kinds of "optimum results" are obtained. Furthermore, Nishiyama et al. does not describe positioning the LCD panel to "stand" during use of the panel. Thus, even if the "relationship" disclosed in Nishiyama et al. were optimized, the "relationships" defined by the inequalities recited in claims 9 and 15 of the present application cannot be obtained. The "relationships" are required in solving problems unique to an LCD module which comprises an LCD panel that is made to stand during the use of the module.

As described above, Nishiyama et al. does not disclose applying H_0, H_1, β and ΔD_1, defined in claim 9 of the present application, as parameters. In addition, the references does not disclose applying H_0, H_1 and ΔD_1, defined in claim 15 of the present application, as

parameters. Thus, the "relationships" defined by the inequalities recited in claims 9 and 15 cannot be obtained easily, wherein the "relationships" are required in solving problems unique to an LCD module which comprises an LCD panel that is positioned to "stand" during the use of the module.

The "relationships" defined by the inequalities recited in claims 9 and 15 are not disclosed in Nishiyama et al., Wang et al., Aastuen et al., Imabayashi et al. or Kashimoto et al., and it is quite difficult to obtain the "relationships". Accordingly, we believe that claims 10-14 and 16-24 which depend from claims 9-15 also have inventive step over the cited references.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in a condition for allowance and a Notice to that effect is earnestly solicited.

Respectfully submitted,

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